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ASSESSING BREEDING MATERIAL IN THE MOUNTAIN AREA OF THE CENTRAL CAUCASUS

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Abstract

In the world agriculture, the potatoes acreage tends to decrease, and production increases to 280 million t, i.e. in some countries, the average yield is 30-40 t/ha, which became possible due to the technological progress in agriculture and related industries. However, the potential of biological and economic productivity of the potato remains far unused. In many states, the yield of potatoes remains low, particularly in Russia. Considering potato yield in the Russian Federation, we can state that in the southern areas, due to the climatic conditions, this indicator leaves much to be desired. Due to the hot summer and the high infectious background of viral disease carriers, the seed qualities of prime reproductions degenerate rapidly. All this obliges searching for the best variants of cleaning seed tubers from viral, viroid and mycoplasmal diseases. The lack of high quality planting material, untimely varietal updating, introduction of non-adaptive varieties result in a decreased productivity of the crop and obtaining low yields of tubers with fragile immune system. In this regard, creating potato varieties that are resistant to biotic and abiotic factors of the environment adapted to the conditions of cultivation and ecologically plastic remains an importanttaskof all breeding programs. According to the results of scientific research work (SRW), samples of potatoes that were adaptive to the conditions of the mountains and foothills have been annually taken as donors for future hybridization and creating new immune varieties, based on studying their varietal peculiarities in a collection nursery, and identifying their dominant characteristics. Sources of the main signs that correlate with productivity and resistance to diseases have been detected, which correspond to the created models of varieties for various environmental conditions of mountains and foothills of the North Caucasus region. The maximum attention has been paid to table varieties, and to their resistance to late blight, heat and drought. Individual elements of innovative technologies of

cultivating seed and food potatoes of the most promising varieties and hybrids of Russian and foreign selection have been proposed. Source material has been created, which has been gathered by the complex of valuable economic and biologic features. Parameters of growing sprouts have been justified for various planting schemes, and temperature regimes in the conditions of artificial lighting.

Keywords: potatoes, selection, adaptation, immunity, yield, marketability**.**

1. Introduction

In the modern plant breeding, studying ecological and genetic bases is due to specifics of crop production, functioning of permanent assets and the objects of labor, which is performed in accordance with the fundamental laws of nature development. Using the latter in the practical activities makes it possible to better understand the limitations and opportunities in controlling adaptive reactions of biological components of agrobiogeocenoses and agroecosystems, i.e. to technologize fundamental knowledge [3;8].

In other words, formation of ideas about the adaptive potential of higher plants as a function of the relationship between their genetic systems of ontogenetic and phylogenetic adaptation nature is not only of theoretical importance, but is also important for developing systematic approach to controlling adaptive reactions at the levels of an individual, population, agrocenoses, agro-ecosystems, landscapes and biosphere, including in implementation of integrated breeding and agronomic programs. The ecological and genetic analysis of the regularities of forming adaptive reactions of cultivated plants and the way of their endogenous and exogenous control developed on this basis determine the leading position of ecological genetics among other scientific disciplines in justifying the strategy of adaptive intensification of crop production [11;12;18;34].

From the above, it follows that the ecological genetics of cultivated plants focuses on integrated approach to adaptive control over plants capacity, agrocenoses, agroecosystems and agrolandscapes, based on the ideas about them as unified biological systems and the complex action of environmental factors (abiotic and biotic) on the adaptive reactions in agrobiogeocenoses. That's why biologization of the intensification processes for achieving the maximum crop productivity should be based on the systematic approach to the endogenous and exogenous regulation freely flowing adaptive reactions of important biological components in agrobiogeocenoses, agro-ecosystems and agricultural landscapes in order to increase their yield and environment improving functions (photosynthesis, soil-protecting, phytosanitary, bioenergetic, etc.). The systematic approach to controlling the adaptive potential of these complex biological structures makes it possible to solve a number of important issues of productivity and quality in

crop growing in new ways [2;38]. Numerous data indicate the close relationship between the quality of the harvest (the content of biologically active substances, taste, marketability) and the overall environmental sustainability of the species and varieties. The advantage of the species with high total adaptability is also in their ability to neutralize or mitigate the negative consequences of the action of the natural and/or anthropogenic stressors (thanks to protective and compensatory and other reactions), while the potential of specific adaptability can be dramatically reduced because of the correlative relationships between the features.In this context, the growth of plant resistance to biotic stress factors, including horizontal resistance to pathogen, should be regarded as an integral part of their overall sustainability [35; 36].

Among the many limiting factors of the environment the temperature is one of the most important, since there is a close link between the potential productivity of plants and their disability to adapt to the temperature stress and, consequently, to optimize these conditions, the processes of photosynthesis, respiration, absorption of mineral elements and others. The mechanisms used for this purpose are in most cases conditioned by reduction of the length of the vegetation period, which in its turn usually leads to a decrease in potential yield.Therefore tolerance mechanisms have a paramount importance in enhancing resistance of cultivated plants to thermal stress.However, in this case, the main obstacle is the narrow limits of the respective genetic diversity in the gene pools of important crops [1, 2, 33].

For the conditions of the mountains and foothills with rapid changes in temperature the tolerance of varieties is an actual problem [3, 4].

Potato belongs to the cultures that differ to a great extent in infestation by diseases.A viral disease is one of the most damaging.Creation of sustainable (immune) varieties is the crucial thing in the fight against it.Improving the sustainability of immunity of the produced varieties continues to be one of the most important tasks in potato breeding.To be successful in this task, it is of paramount importance to implement widespread and effective use of the most valuable source materials on the basis of fully involving extensive collection of wild and cultivated species and varieties of potatoes for resistance to viruses, late blight, nematode, cancer, etc. [5, 6, 29].

Viruses are of great ecological significance, as they have negative impact on the productivity of the majority of cultivated plants, especially vegetatively propagated.Currently, laboratory diagnosis of viral infections of seed potatoes is carried out mainly by enzyme immunoassay (EIA). This method has high specificity and sensitivity, allowing to quantify virus in the extract with a concentration of 1 ng/ml.The most important advantage of the method

is its high performance, which makes it possible to analyze the tens and hundreds of samples in a short (2 days) time [5; 14; 27].

Since the beginning of the 90s in the Russian Federation there has been a considerable decrease in potatoes yield due to the omnipresence of viroid of Potato spindle tuber (SWCC), which affected most of the varieties.Currently, in the number of Russian regions the disease caused by the viroid is considered the most common for potato and economically the most dangerous [9].SWCC is a small (about 360 nucleotides) circular RNA molecule with a highly developed secondary structure [13]. Viroids do not encode proteins; they cannot therefore be detected by ELISA.Potatoes viroid infection can be determined by methods based on molecular hybridization of nucleic acids.Generally diagnostic forms for detection of viroids use the method of molecular hybridization with cRNA - probes labeled by Hygoxigenin or PCR [7; 19; 20; 23].

Under the continental climate of central Russia the most harmful is the PVY virus that causes the degeneration of potatoes, especially in mixed infections with PVX.Therefore, the main objective of the work was carried out by isolation and the search for sources of immunity to viruses PVY and PVX [21; 22].

When selecting varieties for different purposes, an important task is to combine the economically valuable features with resistance to viruses, *P. infestans, Alternariasolani*, golden potato cyst nematode and the stress factors [24, 37].

To create varieties and hybrids that exceed the existing ones, new approaches and methods are needed.

One of the most important modern requirements for breeding is to conduct research on the purpose-built program, which is expressed in the preliminary modelling of the variety or the hybrid, which is necessary to create [3; 4; 17; 25; 26].

For the main potato breeding lines there is an extensive literature, but little is known about the development of models, including selection, primary seed production and potato cultivation technology.A study on the development of models for the specific environmental conditions and regions is conducted in Russia and abroad [3; 4; 18; 24; 28].In the developed models they usually consider not only yield, number of tubers under a bush and their characteristics, but also the rate of growth of the leaf surface, the nature of the structure of the bush, the rate of tuber formation, resistance to disease, pests and adverse environmental factors, as well as a number of biological indicators [25; 26 ; 30; 31; 32].

There are 39 specific, i.e. potato inherent, traits in the direction of which the most countries carry out selection of a given culture.

Model potato varieties developed for the conditions of the Non-chernozem zone of Russia, Belarus, northern Ukraine cannot be used in the practical work of breeders, creating new varieties for cultivation in the North Caucasus.This region has a great diversity of natural conditions.Analysing the climatic conditions of the North Caucasus [6], plant moisture issues during the growing season of 1951-1972. [3, 4], the researchers came to the conclusion that the conditions of the region, except for the Karachayevo-Cherkessia republic and mountainous areas, require early, mid-early and mid-season varieties of the maturity groups.They must differ not only by high yields, disease resistance and other economically valuable traits, but, above all, they should be heat- and drought-resistant, and therefore have ecological plasticity.

In favour of what has been said about the North Caucasus requirements to ripening groups of varieties and hybrids, witness the fact that in 1-2 decades of July, when the early and mid-season group varieties pass massive accumulation of crop and mid-late seaon and late seaon varieties only come in the budding stage - the beginning of bloom, there comes hot and dry weather adversely affecting tuberization. The temperature rises to 36-42^0 C, and more.Such conditions in the steppe, forest-steppe, and, often, in the piedmont zone on heavy soils continue in the 3rd decade of July and in 1st-2nd decades of August. Accumulation of tubers of such varieties, including those relating to mid-season, runs only at night. Given the weak moisture content of the plants in this period, low yields of potatoes of middle-late season maturity groups are quite natural [3, 4].

In the mountains almost every year in early September in the early morning hours there are frosts, which damage the tops, and in some years even destroy them, the harvest of tubers of mid-season and late-season varieties accumulate no more than 62-67% of the biologically possible volume. Both under planar and mountain conditions the varieties of these ripeness groups not only reduce productivity, but also worsen the quality of planting material. In this regard, it became necessary to devise ad hoc models,by creating different groups of varieties of ripeness for the specific conditions of different zones of the Northern Caucasus [3; 4; 6].

To stabilize the yield, the potatoes varieties cultivated in the zone of the North Caucasus, must have a sufficient level of adaptability to growing conditions. High adaptability to environmental factors suggests resistance to heat, drought and short-term waterlogging that happen in some years in the foothills of North Ossetia-Alania and the region.

The main methods of selection that allow to realize the creation of varieties in accordance with the proposed optimal model, developed based on the results of genetic analysis of progeny, assessment of general combining ability of parental forms and the results of practical plant breeding in our country and abroad, are as follows:

- interspecific hybridization, which allows for the transfer of genes for resistance to diseases and pests in the produced varieties;
- experimental mutagenesis, giving the opportunity to break the negative link between economic traits and conduct their recombination;
- inbreeding and accumulative cross-breeds to concentrate the polygenes;
- combinational breeding for heterosis and increase in productivity;
- the use of appropriate methods of selection of soil areas;
- holding of elections under conditions which are typical for commercial potato growing zones.

Therefore, to create models for the future variety comprehensive assessment of the source materials is important.

2. Terms and Methods of Research

The Republic of North Ossetia-Alania is located on the northern slopes of the Central Caucasus.Despite its small area (8 thousand km 2), the territory of the republic is characterized by a wide variety of soil and climatic conditions.It is divided into three natural zones, each of which includes subzones and microzones [6].

Our studies were carried out in the mountainous area (1400 m above sea level, the branch of the Plant Growing Department of the Faculty of Agriculture of the Federal State Budgetary Educational Institution of Higher Education of Gorsky State Agrarian University (FSBEI HE Gorsky SAU) vlg. Gorny Kurtat of Alagir District and in stationary greenhouse. According to the guidelines developed from 2009 to 2015, the FSBEI HE Gorsky SAU has studied in the collection and maternal nurseries of the mountainous area 120 varieties and interspecific hybrids of domestic, foreign and own selection potatoes from 34 foreign countries (far abroad: United States, the Netherlands, Germany, France, China; and near abroad: Belarus, Ukraine, Central Asian republics, the Caucasus, etc.), and from a number of research institutions (RI) of the Russian Federation. Varieties and hybrids were tested for resistance to diseases, pests, as well as for the aggregate of agronomic traits. Five varieties for various reasons have been culled.

Research was conducted on a range of agronomic traits according to the developed models varieties for a given agro-climatic zone: biochemical composition of tubers of different varieties of the source material, their productivity, resistance to viral and fungal diseases, the degree of darkening of raw or cooked tubers, etc.

The infestation of plants of potato by virus diseases were determined by visual assessment according to methodology by A.G. Zykin [8], the virus in a latent form - by using of an improved method a buffer solution of ammonium sulphate, as well as by the method of enzyme immunoassay (EIA) - disease-free seed potatoes.

Assessment of the stability of potato varieties to late blight on leaves and tubers in the field was determined by a 9-point scale.

In determining the percentage of starch and dry matter in tubers the gravimetric method by Ganzin and Makunin was used. Darkening of pulp of raw and cooked tuber was evaluated according to methodological guidelines for assessing the suitability of varieties for processing and storage (All-Russian Research Institute of Potato Farming (ARIPF), 2008).

Visual surveys, observations, analyses and evaluations were carried out according to the procedures of ARIPF (1967, 1980, 2010), and the initial assessment of the hybrid material - according to the method of K.Z. Budin [12]. Resistance to late blight was determined according to method of I.M. Yashin and according to CMEA procedure [24]. The parameters of photosynthetic activity of potato plants were determined according to accepted methods [11, 12]. Mathematical analysis of productive data was performed according to the accepted methods.

In the first year nursery during the growing season the researches performed 3 evaluation and culling of genotypes affected by viral diseases, phytophthora, macrosporiosis, as well as culling of the late-ripening forms, and of the overgrown tubers.

Gathering of seedlings of the 1st year was performed in early August:

4 tubers were taken according to combination of each breeding pair - the first two for further testing in one-tubers nursery, the second - for the infection tests for resistance to viral diseases, heat and drought in the mountain and foothill areas. In the nursery of the 2nd year seedlings- the first tuber offspring of the one-tuber was planted by combinatorial numbers with an nutrition area of 70 x 30 cm. During vegetation the researched carried out both visual inspections and enzyme immunoassay on the latent infection of viruses in plants, followed by culling of infected samples. In the nursery of seedlings of the 3rd year (the second seed tubers) genotypes were grown on single row plots with the number of plants ranging from from 8 to 10 and nutrition area 70 x 30 cm. During the growing season phenological observations, surveys and culling of genotypes on negative signs were conducted. The released hybrids were prepared for further study in a preliminary test nursery.

In the pre-test nursery the own hybrids were planted by 10 and 20 tuber plots and the recognized variety Udacha - St (standard) was planted in every 19 rows.

In the main test nursery the plants were planted by 20-tuber plots with planting scheme from 70 to 30 cm. The early variety Udacha was used as a standard. During the growing season phenological observations, surveys and culling of

genotypes on negative grounds were also conducted, but more in a more rigid form than in other nurseries. The released hybrids were prepared for further study in the competitive test nursery.

Experimental scheme provides environmental testing of potato tubers in the collection nurseries:

a) 61 × 20 (sixty-one varieties of 20 tubers each - in a plot there were 2 rows of 10 tubers each);

b) 21 × 40 (paternal nursery: 21 varieties of 40 tubers each - a plot of 2 rows of 20 tubers each).

The varieties with dominant signs were identified and put in the parent nursery as a donor for a further crossing in various combinations. Tubers weighing 60-80 g were used as the seeds. Planting was carried out manually on the ridges according to the scheme 70 x 30 cm. Mineral fertilizers (NPK) were applied by hand to the spring before the re-formation of ridges. Caring for planting was conventional; inter-row tillage was carried out as the weeds appeared and the soil compacted.

The plants were treated against the Colorado potato beetle against phytophthora with drugs Akhtar and Reedomil - Gold.

The aim of the research is the breeding of high-yield potato varieties with high stable immunity to diseases for the upland conditions of RNO - Alania and the recovery of a number of recognized varieties of the virus infection.

The research program included the following **tasks**:

1. To carry out the selection of productive and immune potato samples for hybridization on the basis of previously established models of varieties for the region;
2. To rate genetic progeny of previously crossed parental variety samples based on phenotypic, genotypic, productive and varietal characteristics;
3. To justify the use of germinated sprouts as primary seeds.

3. The Results of the Research

We developed the structure of optimal potato varieties of models for the major potato growing areas of different soil-climatic zones of the North Caucasus; this structure included, apart from economic purpose, the requirements to genotype and phenotype, in which the selection should be conducted, and to arrangements for care of plantings, taking into account environmental protection. When optimizing the controlled environmental conditions (soil treatment, timeliness of measures for the care and protection of plantations from pests and diseases, etc.) it can be expected to display the maximum potential of varieties and hybrids in accordance with the planned parameters of the model, according to which we have made maturity groupings of varieties in the studied collection variety nursery,

replenished every year. The group does not include all the studied varieties due to their vastness and the level of knowledge of some parameters. Four groups are allocated by the precocity:

Early rosa, Pirmunes, Borodyansky pink, Impala, Darenka, Karatop, Udacha, Vitesse, Kamensky, Feloks, Lyubava, Rosara, Krasavchik, Cascade polissky, Sante, Latona, Zhukovsky early.

Mid-early season group: Nevsky, Rezerv, Sotochka, Vladikavkazsky, Christina, Secura, Visa, Adretta, Bars, Andra, Predgorny, Mozart, Meteor, Innovator, Kuznechanka, Curazh, Volzhanin, Ladozhsky, Svitanok kievsky, Darnitsa, Radrigo, Janka, Infinito, Zarayka, Ryabinushka, Canberra, Silvana, Lileya, Falvarak, Fabula, Dubrava, Rucheyok, Uladar, Premjer, Dolphin, Gart, Kolobok, Natalia, Prolisok, Nadezhda, hybrids 87.759/3 10.2/664, 10.2/58, 10.24/62 10.10/2.

Mid-season group: Roko, Nikita, Léon, Aguti, Nakra, Resurs, Aurora, Pribrezhny, Krepysh, Revansh, Romano.

Middle-late season group: Golubizna, Libana, Nikulinskiy, Violet.

Golubizna, Libana, Nikulinskiy, Violet.

Supportive breeding presupposes selection breeding, seed production in the most favourable conditions of the zone in accordance with the scheme. Accelerated breeding and primary seed production of the bred potato varieties is based on the use of biotechnology, microclonal propagation in *invitro* culture.

The results of our research have allowed us to allocate a valuable source material for further work in the area of breeding to produce new potato varieties with a high degree of adaptation to the conditions of the vertical zoning of the North Caucasus region.

Out of 120 varieties of subjects in the collection nursery 82 potato varieties were included in the parental nursery.

In the parental nursery out of 82 varieties field test survived 77 varieties, among them the largest crop of more than 30 tons/ha was formed by: Udacha, Scarb, Ragneda, Predgorny, Amalia, Zarayka, Lileya, Kolobok, Nikulinskiy, Uladar, Lyubava, Ladoga, Volzhanin, Dubrava, Radrigo, Falvarak, Pribrezhnyi. The maximum productivity is marked for the variety Pribrezhnyi - 44.6 t/ha.

Analysing the data on the of merchantability of potato varieties, one can conclude that under 70% level it fell on varieties Borodyansky pink and Secura (66.6 and 68.1%, respectively), from 70 to 80% - on varieties Pribrezhnyi, Visa, Feloks, Impala, Early rosa, from 80 to 90% - on varieties Pirmunes, Christina, Radrigo, Salin, Nikita, Latona, Sante, Lyubava, Bars, Darenka. For all other varieties, it was above 90% with the maximum on varieties Roko, Nadezhda, Darnitsa and Udacha (100%).

The average mass of 1 marketable tuber ranged from 43.4 g (Borodyansky pink) to 153.2 g (Zarayka). According to Variety Lileya, 10.24/62, Roko, Nevsky, Kolobok, Skarb, Aguti, Falvarak, Visa, Uladar, Rucheyok, Udacha, Curazh, Amalia, Golubizna, Sagita, Nikulinskiy, Svitanok kievsky, Lyubava, Nikita, Darnitsa, Ladozhsky, Zarayka the tuber mass was higher than 100 g.

In the collection nursery the investigated 68 of the 77 hybrids had a round or rounded-oval tuber. Varieties Vladikavkaz, Roko, Nevsky, Udacha, Nikulinsky were elongated-oval; Nadezhda, Kamensky, Ragneda were elongated.

34 varieties were completely free of viral diseases. The lowest grade of immunity demonstrated Volzhanin. The average prevalence on varieties amounted to 0.6%.

The average yield for all varieties investigated over the years of the study was 23.6 t/ha, some varieties have formed more that 30 t/ha during this period (Table 1 and Table 2).

Table 1. Indicators of the crop structure and quality of tubers of the source material of varieties of parental nursery in mountainous areas of North Ossetia - Alaniya. 2009-2015.

Variety, hybrid	g/bush, average	marketable tubers, pieces.	Weight of marketable tubers, g/bush	% of marketable tubers	Avg. mass of 1 marketable tuber, g	Number of small tubers, pieces.	Weight of small tubers, kg	Yield, t/ha
Predgorny		144	10.2	97.1	70.8	13	0.3	30.8
Volzhanin	737.5	70	5.5	93.2	78.5	18	0.4	34.6
Pribrezhny	950.0	175	14.4	75.7	82.3	210	4.6	44.6
Radrigo	823.5	140	12.0	85.7	85.7	97	2.0	38.7
Kolobok	655.5	114	11.5	97.4	102.8	13	0.3	30.8
Skarb	650.0	124	12.8	98.4	103.2	11	0.2	30.5
Amalia	655.0	110	13.0	99.2	118.1	9	0.1	30.8
Zarayka	656.2	65	10.0	95.2	153.2	0	0	30.8
Dubrava	752.9	130	12.1	94.5	93.0	28	0.7	35.4

Lipeya	656.2	100	10.0	92.2	100.0	20	0.5	30.8
Falvark	850.0	160	16.7	98.2	104.3	13	0.3	39.9
Uladar	733.3	101	10.9	99.0	107.9	7	0.1	34.4
Lyubava	735.0	102	13.0	88.4	127.4	70	1.7	34.5
Ladozhsky	735.3	80	12.1	96.8	151.2	10	0.4	34.5
Udacha	647.0	100	11.0	100.0	110.0	0	0	30.4
Nikulinsky	666.6	110	13.4	95.7	121.8	23	0.6	31.3
Ragneda	653.8	84	8.2	96.4	97.6	14	0.3	30.7

Table 2. Assessment of varieties of parental nursery for phenotypic characteristics in mountainous area of North Ossetia - Alaniya. 2009-2015.

Variety, hybrid	**Shape of tuber, points**	**Colouring of tuber, points**	**Tuber flesh colour**	**The depth of eyes, points**	**Colouring of eyes, score**	**Visual assessment on viral diseases, %**	**Phytophthora of tuber, points**
Predgorny	1	1	y	7	3	0.0	2
Volzhanin	1	1	w	5	1	3.3	8
Pribrezhny	1	1	w	9	1	0.0	8
Radrigo	1	2	l.-y.	5	1	1.0	8
Kolobok	1	2	l.-y.	9	3	0.0	9
Skarb	1	4	y	5	1	0.0	7
Amalia	1	1	y	5	3	0.0	8
Zarayka	1	2	cream	7	3	0.0	9
Dubrava	2	2	w	5	1	0.5	7
Lipeya	2	2	y	9	1	2.0	9
Falvark	2	2	y	9	1	0.0	9
Uladar	2	2	y	5	1	0.1	9

Lyubava	2	3	w	7	3	0.0	8
Ladozhsky	2	1	w	5	1	1.5	8
Udacha	4	1	w	7	1	1.5	8
Nikulinsky	4	2	w	5	1	0.0	8
Ragneda	5	4	cream	5	1	1.0	7

Note. In Tables 2 and 3 numbers indicate point system of assessment of morphological indicators of tubers:

- shape of tuber: 1 - round, 2 - round-oval, 3 - oval, 4 - elongated-oval, 5 - extra long, 6 - very long;
- colour of tuber: 1 - white 2 - yellow 3 - red 4 - pink 5 - blue 6 - light blue, 7 - reddish-brown;
- eyes depth: 1 - very deep, 3 - deep (3.5 mm), 5 - means (2-3 mm), 7 - small (2 mm), 9 - surface;
- colour of eyes: 1 - white, 2 - yellow, 3 - red, 4 - blue;
- stolon trail depth: 1 - very deep impression, 3 - deep, 5 - average depth, 7 - shallow, 9 - flat (shallow)

We have studied the genotypic features of the phenotype, indicators of disease resistance and productivity of seedlings of the 1st year depending on the presence of the genes of wild varieties of potatoes, such as S. demissum, S. acaule, S. Andigenum (Table 3). As the parental forms we used varieties of domestic and foreign selection: RedScarlett, Alyona, Meteor and Briz. We revealed direct relationship of productivity with the presence of specimens of genes in wild species: varieties containing the genes of type S. demissum, showed the smallest harvest per bush (on average varieties RedScarlett and Meteor 712 g), and the average weight of 1 marketable tuber (56-147 g). The marketability of tubers was higher, reaching 96 to 98% for all varieties. Varieties containing genes of S. acaule, S. andigenum, showed greater productivity: the average for the varieties Alyona and Breeze is 893 g/bush. Their marketability was at the same level - 97 ... 98%. The maximum germination of seeds - 100% - is noted in the combination 72 (Alyona x Briz) enclosing both the paternal and maternal genes S. andigenum and S. acaule, which indicate their positive impact on the process. With the largest number of families in the combinations of 73 and 74 at harvest their limiting number was selected by a combination of 72 (53.6%). The minimum percentage of available families is marked over a combination 74 - Meteor x Briz - 17.6%. Hence, the largest number of genotypes in the populations were selected for combination 72, by 2-2.5 times exceeding the 73 and 74 (454 and 141 vs. 243, respectively). Evaluation of morphological traits showed variation in the form of tubers from round to elongate-oval, the depth of the eyes from small to medium and stolon trail from the surface to the small in the combinations containing genes S. demissum. For all combinations no tubers colour change was observed (white).

Consequently, the combinations containing the genes of wild species S. acaule and S. andigenum provided better productivity, germination and selectiveness (Table 3).

Table 3. Inheritance of sustainability indicators and morphobiological traits in seedlings of year 1, depending on the presence of genes of wild species in the parental forms in mountainous areas of North Ossetia - Alania of selection by FSBEI HE Gorsky SAU. 2015.

combination No	Parental forms containing genes of wild species		Productivity of parental forms						Sown seeds, pcs.	Germination rate	Singling, pcs.	Total families units.	Visual culling of families by diseases, pcs.			Phytophthora resistance of tops, points	Selected during harvesting of families		Selected of genotypes in populations	Prevailing economic-valuable morphological characteristics of the tuber, points			
			♀			♂																	
	♀	♂	g/bush	marketable tuber	% of marketable tubers	g/bush	marketable tuber	% of marketable tubers					viral	fungal	bacterial		Number, pcs.	%		shape	colour	eyes depth	stolons trail depth
72	Alyona –S. andigenum, S. acaule	Briz – S. acaule, S. andigenum	829.0	86-167	97.0	957.4	97-154	98.0	150	100.0	150	150	0	12	0	8	74	53.6	454	1	1	5	7
73	Red Scarlet –S. demissum	Briz – S. acaule, S. andigenum	574.4	56-102	96.0	957.4	97-154	98.0	180	98.9	175	175	0	10	0	8	84	50.9	141	1	1	7	9
74	Meteor – S.	Briz – S.	851.0	102-147	98.0	957.4	97-154	98.0	220	85.0	187	187	0	17	0	7	30	17.6	243	4	1	5	7

	demissum	acaule, S. andigenum																				
Average			751,4	81,3-138,6	97.0	957.4	97-154	98.0	183.3	94.6	170.6	170.6	0	13	0	7.6	62.6	40.7		2	1	5.6	7.6
total									550			512							838				

Table 4. The results of studies of populations of genotype across the combinations in nursery of seedlings 2nd year - first tuber progeny in mountainous areas of North Ossetia - Alania.

Combination	Origin	The number of planted genotypes, pcs	Number of germinating genotypes, pcs.	Visual culling at cleansing by diseases, pcs.				points	Selected during harvesting		Culled during harvesting, pcs.		Overall tops, points	Selected genotypes, pieces.
				viral	fungal	bacterial	underdeveloped		quantity pcs.	%	by diseases	by morphological features		
Selection of FSBEI HE Gorsky SAU														
57	Sinyukha Early rosa	196	193	0	0	0	0	6	8	4.2	83	100	5	8
60	Roko Romano	93	90	10	0	0	0	9	5	5.5	44	41	5	5
Selection of ARIPF named after A.G. Lorkh														
115	Girass Odissey	24	24	0	2	0	0	6	6	25.0	11	7	3	6
266	Zhivnitsa Kondor	32	32	4	3	0	0	6	12	37.5	13	7	5	12
473	Blakit Yagodka	2	2	0	0	0	0	7	2	100.0	0	0	3	2
936	Zhivnitsa Adora	13	13	0	0	0	0	9	5	38.4	3	5	3	5
Total		442	427	35	12	0	0	7.2	48	27.7	199	180	4.1	48

Note. In Tables 4 and 5 overall tops are given in points where 1 - very bad, 3 - poor 5 - medium 7 - great.

In the nursery of seedlings of year II (Table 4) research was conducted for 9 combinations. Total planted genotypes were 442, of which 196 were the combinations of 57 (Sinyukha Early rosa). All seedling germination was high, being in the range of 100%. Combinations 57 (Sinyukha Earlyrosa), 115 (GirassOdyssey) and 936 (Zhivnitsa x Adora)

were free of viral, fungal and bacterial diseases. The highest prevalence of viral disease is marked over a combination 484, by fungal - for 699. Combinations of 60, 860 and 936 had a high resistance to phytophthora, 57, 115, 266 and 484 - had average resistance.

The maximum amount allocated during harvesting of genotypes - 100% - fell on a combination 473 (Blakit x Yagodka), which was significantly higher than all the others, the selection of which was from 4.2% for combination 57 (Sinyukha Earlyrosa) to 38.4% - for 936 (Zhivnitsa x Adora). On this basis, when harvesting on average for all combinations a total of 27.7% of genotypes was selected, due to the instability of a large number of seedlings to viral and fungal diseases, 199 of which were culled for this reason, and 180 - for the set of morphological traits. It is noteworthy that the infestationby bacterial diseases was absentin the nursery. Underdevelopment of plants was not observed either. Overall tops was 4.1 points (almost hight-alignedplants with small curl), reaching a peak - 7 points - over a combination 115 (well developed plants, evenness of plant and leaf plates) and the minimum - 3 points - for the 115, 473, 484, 699 and 936 (not aligned plants, improperly formed leaves). Ultimately, 48 of genotypes were selected, 12 of them - for combination 266.

Thus, the most productive combination was 266 - Zhivnitsa x Condor.

Table 5. The results of studies of genotypes by combinations in the nursery of seedlings of 3rd year - 2nd tuber progeny - in mountainous areas of North Ossetia - Alania.

combination No	Origin	Number of germinating genotypes, pcs.	Overall tops, points	Predominant type of bush, points	Power of development, points	Visual culling of genotypes at cleansing by disease, pcs.					Culling during harvesting by tuber diseases, pieces.	Selected during harvesting		Tubers resistance to phytophthora, points.	Selected for the transfer to the preliminary test nursery, pcs.
						mild mosaic	wrinkled mosaic	leaf twisting	leaf curl	banded mosaic		quantity pcs.	% selection		
Selection of FSBEI HE Gorsky SAU															
39	KamenskyVolzhanin	315	5	5	5	0	4	2	6	0	297	18	5.7	8	18

40	Lyubava Lugovskoy	80	5	5	5	1	0	2	2	0	58	22	27.5	8	22
41	Lyubava Bars	80	7	5	5	1	3	1	1	0	20	60	75.0	8	60
42	Leona Nakra	80	5	5	5	1	0	1	1	0	68	13	15.0	8	13
50	Kuznechanka Udacha	100	7	5	5	1	3	2	3	0	73	27	27.0	7	27
58	Udacha Sinyukha	245	7	9	9	0	3	0	0	0	192	53	21.6	8	53
Selection of ARIPF named after A.G. Lorkh															
167	NalchinskyKrepysh	39	7	5	5	0	0	3	1	0	24	15	38.4	8	15
225		40	5	5	5	0	3	1	0	0	30	10	25.0	9	10
305	733-65 Krepysh	40	5	9	9	2	4	2	0	0	23	17	42.5	9	17
483	81.14/61 Zdabytok	738	7	9	9	0	0	0	0	0	560	177	23.9	8	177
944	733-65 Aurora	193	7	9	9	0	1	2	0	0	172	21	10.8	8	21
Total		1950				6	21	15	13	0	1517	433			433

Note. Numerals indicate numerical score:

- predominant type of bush: 1 - spreading, 5 - semispreading, 9 - upright, compact;
- power of development: 1 - poor, 5 - average, 9 - powerful.

In the seedlings nursery of the year III (Table 5) FSBEI HE Gorsky SAU and ARIPF named after A.G. Lorkh tested 11 combinations of breeding.

On the whole, from 1,950 germinated seedlings in the pre-test nursery 433 pieces were selected, of which 177 belonged to combination 483 (81.14/61 x Zdabytok). The smallest number of genotypes (10 pcs) were isolated over a combination 255.

Overall rating of vegetated plants was quite high - from the average for combinations 39, 42, 40, 225, 305 to the excellent - for 41, 50, 58.167, 44, 483 with a predominance of semi-wide bush type with an average power development. Combinations 58, 483, 305 and 944 have compact erect bush with well developed strong stalks taller than 70 cm. Visual observation of leaves showed no viral diseases in combination 483 (81.14/61 x Zdabytok). To the greatest degree the investigated seedlings were infested by wrinkled mosaic, to a lesser - by the ordinary one. The banded mosaic was not observed.

In general, 1517 diseased genotypes were culled, i.e. 77.8% of the shoots.

In general, 1,517 diseased genotypes were culled, i.e. 77.8% of the shoots. On the average across the combinations we selected during harvesting, 28.4% of the seedlings, with the minimum for 39 (Kamensky Volzhanin), with the maximum for 41 (Lyubava x Bars), which accounted for 5.7% and 75.0%.

On the whole all combinations showed high resistance to late blight for tops (on average - 8 points) across the nursery.

Thus, the best sampling of the second tuber generation in the nursery showed combination 483 (81.14/61 x Zdabytok).

In the preliminary tests nursery (Table 6) investigations were carried out for combinations 26, 30, 34, 35 and 37. For example, in combination 26 (87.759/3 x Rezerv) assessment was conducted for 31 hybrids, for each of which from 6 to 12 bushes were left for harvesting with an average marketability of tubers totalling 89.3%: from 64.5% for hybrid 11.26/19 to 98.8% for 11.26/35.

Average weight of 1 marketable tuber on average totalling 89.3 g for the combination ranged from 41.9 g (11.26/19) to 112 g (11.26/33).

Table 6. Indicators of studies of the structure of harvest, morphobiological features of hybrids in the preliminary test nursery 26th breeding of FSBEI HE Gorsky SAU selection in the mountainous areas of North Ossetia - Alania.

Hybrid	Origin	Number of bushes to harvest, pcs.	Total weight, kg.	The number of marketable tubers, pieces.	% of marketable tubers	Average weight of 1 marketable tuber, g	Mass of small tubers, kg	Tuber shape	Tuber colour	Tuber flesh colour	Eyehole depth	Eyehole colour	Stolon trail depth	Visual assessment on viral diseases,%	Tuber resistance to phytophthora, points	Yield, t/ha
11.26/578	87.759/3 Rezerv	11	10.0	108	98.5	91.2	0.15	round	w.	w.	sh.	w.	surf.	0	9	42.72

11.26/470	87.759/3 Rezerv	6	6.2	90	96.7	66.6	0.2	round	w.	cream	sh.	w.	mid.	4.1	9	48.56
11.26/816	87.759/3 Rezerv	10	10.4	93	80.7	90.3	2.0	round.-flat.	w.	w.	mid.	w.	mid.	0	6	48.80
11.26/215	87.759/3 Rezerv	7	7.6	89	89.4	76.4	0.8	round.-flat.	w.	bright white	deep.	rose.	surf.	3.0	7	51.02
11.26/241	87.759/3 Rezerv	7	7.8	133	96.1	56.4	0.3	round	w.	cream	mid.	rose	mid.	0	8	52.35
11.26/475	87.759/3 Rezerv	6	6.9	117	86.9	51.2	0.9	round	w.	bright white	sh.	w.	surf.	4.5	9	54.05
11.26/35	87.759/3 Rezerv	7	8.3	100	98.8	82.0	0.1	round	w.	bright white	mid.	w.	mid.	3.0	9	55.7

4. Discussion of Results

Assessment of morphological traits showed the prevalence of rounded white flesh tuber with white color of skin and an average depth of eyes and stolon trail.

For hybrids 11.26/503 11.26/149 11.26/98 there was yellow flesh, for 11.26/525 11.26/14 11.26/41 11.26/503 11.26/149 11.26/215 11.26/578 - deep location of eyes that increases the amount of waste during abrasive cleaning of tubers. Visual assessment of plants for any viral diseases showed their absence through 21 hybrids, the infestation of others ranged from 0.1%(11.26/739) to 4.5% (11.26/475), which averaged 0.8%. The hybrids have shown themselves highly resistant to late blight: on average for tubers it was 7.6 points with minimum for 11.26/19 11.26/816 11.26/36 (30% of infested plants) and the maximum for 11.26/578 11.26/35 11.26/470 11.26/475 (presence of single spots).

The studied combination is highly productive. The average yield for hybrids was 38.1 t/ha. For the seven hybrids the harvest exceeding 40 t/ha was noted: 11.26/578 11.26/470 11.26/816 11.26/215 11.26/241 11.26/475 11.26/35 with the achievement of the maximum of the last of the above samples totalling to 55.7 t/ha, which is much higher than the average yield in the North-Caucus region.

On this basis, it may be concluded that in combination 26 the best hybrids were 11.26/578 11.26/241, of high productivity, marketability and resistance to viral diseases.

Table 7. Indicators of studies of the structure of crops and of microbiological features of hybrids in the preliminary test nursery of combinations # 30, # 34, # 37, selection of FSBEI HE Gorsky SAU in mountainous areas of North Ossetia - Alania.

combination No	Origin	Number of bushes to harvest, pcs.	Total mass, kg	The number of marketable tubers, pieces.	% of marketable tubers	Avg. mass of 1 marketable tuber, g	Mass of small tubers, kg	Tuber shape	Tuber colour	Tuber flesh colour	Eyehole depth	Eyehole colour	Stolon trail depth	Visual assessment on viral diseases,%	Tuber resistance to phytophthora, points	Yield, t/ha
11.30/22	Predgorny Libana	11	7.6	87	93.4	81.6	0.5	round	w.	cream	deep	w.	surf.	2.8	9	32.47
11.30/26	Predgorny Libana	7	6.2	70	95.1	84.2	0.3	round	w.	y.	sh.	w.	surf.	2.8	9	41.62
11.34/1	Innovator Sinyukha	8	9.6	88	99.5	108.6	0.04	el.	red	ros. l-y	sh.	rose	surf.	0	4	56.4
11.34/21	Innovator Sinyukha	8	6.2	86	91.9	66.2	0.5	el.	rose	l.-cream.	surf.	rose	surf.	0	5	36.42
11.37/40	Sinyukha Kuznechanka	11	9.4	93	100.0	101.0	0	el.	l.-v.	cream	sh.	v.	surf.	0.1	7	40.16
11.37/23	Sinyukha Kuznechanka	10	7.8	93	99.7	83.6	0.02	round.-flat.	w.	w.	sh.	w.	surf.	0.1	3	36.66

Studies conducted in the pre-test nursery (Table 7) for hybrids of combination 30 (PredgornyLibana), 34 (Innovator x Sinyukha) and 37 (Sinyukha x Kuznechanka) showed their high marketability, with an average composition of 96.9% with a limit 100% for 11.37/40 and the smallest indication of 91.9% for 11.34/21, and the productivity, the maximum of which was 56.4 t/ha (11.34/1) - 17.9 t/ha higher than the average 38.5 t/ha.

Among the indicated hybrids prevailed tuber of rounded shape, most suitable for the manufacture of potato crisps. However, it was noted the presence of elongate tubers, a form of which meets the maximum requirements for the preparation of French fries. Of the hybrids with red, pink, yellow and white color of the skin dominated the last (55%). Flesh color was most different - from the white to pink with a yellow tinge of the vascular ring. Both shallow depth of eyes, and of stolon trail were noted. Assessment of of hybrids resistance to fungal diseases revealed a severe infestation of tubers with late blight. Visual examination of plants for any viral diseases showed their complete absence in hybrids 11.34/1 11.34/21, 11.34/2. For other samples this parameter ranged from 0.1 (11.37/58 11.37/23 11.37/33 11.37/40 11.37/66 11.37/82) to 2.8% (11.30/22 11.30/26, 11.30/1 11.30/5).

Therefore, the best results on the complex of economically valuable traits was hybrid 11.34/1 (Innovator x Sinyukha), which has high marketability (99.5%), productivity (56.4 t/ha), the absence of viral diseases and small eyes.

Table 8. Indicators of studies of the structure of crops and phenotypic traits of hybrids in the preliminary tests nursery # 35 of combination in a mountainous area of North Ossetia - Alania selection FSBEI HE Gorsky SAU.

Hybrid	Origin	Number of bushes to harvest, pcs.	Total mass, g	Number of marketable tubers	% of marketable tubers	The average mass of 1 marketable tuber	Mass of small tubers, kg	Tuber shape	Tuber colour	Tuber flesh colour	Eyehole depth	Eyehole colour	Stolon trail depth	Visual assessment on viral diseases,%	Tuber resistance to phytophthora, points	Yield, t/ha
11.35/160	Innovator Premjer	10	10.0	139	99.0	71.2	0.1	round.-flat.	w.	cream	sh.	rose	surf.	0	9	47.0
11.35/127	Innovator Premjer	10	12.0	135	100.0	88.8	0	round	l.-r.	l.-y.	sh.	rose	surf.	0	9	56.40
11.35/10	Innovato	11	11.0	97	97.2	110.	0.3	round	w.	crea	mid.	rose	mid.	0	8	47.0

7	r Premjer					3				m						
11.35/91	Innovato r Premjer	11	11.6	150	90.5	70.0	1.1	round	l.-r.	y.	mid.	rose	mid.	0.8	8	49.3 5
11.35/12	Innovato r Premjer	10	11.4	90	99.5	126. 1	0.05	el.	rose	brigh t y.	surf.	red	surf.	0	4	53.5 8
11.35/24	Innovato r Premjer	11	12.0	130	99.1	91.5	0.1	round	l.-r.	crea m	sh.	rose	surf.	0	9	51.2 3

In the pre-test nursery, we also investigated combination 35 (Innovator x Premjer), all the 20 hybrids of which showed high marketability and productivity with the average of 96.0% and 41.1 t/ha, respectively (Table 8). At that fluctuation of percentage of marketable tubers ranged from 77.5% (11.35/102) to 100% (11.35/76 11.35/127), productivity - from 31.02 for hybrid 11.35/98 to 56.4 t/ha in 1135/127. We noted a strong variation in the average weight of the 1st marketable tuber on the investigated hybrids - from 37.7 g (11.35/15) up to 126.1 g (11.35/12), which amounted to an average of 87.4 g.

Analysis of morphological traits of hybrids showed the prevalence of round pink of various shades of tubers with yellow flesh and shallow eyes. The absence of deep eyes and stolons trail were revealed.

75% of the studied hybrids for this combination were free from viral diseases.

The average infestation was 0.3%, which is the lowest figure among all combinations of the nursery.

Thus, among the indicated hybrids we allocated 11.35/127 as the maximum productive, marketable (100% and 56.4 t/ha, respectively), resistant to fungal and viral diseases, and has excellent external data (small eyes, superficial stolon trail, rounded shape of tuber).

For the first time hybrids assessment was conducted in the nursery of the main test on two combinations:

2 (Bars x Adretta) and 11th (Roko x Romano).

The control option was the early variety of domestic breeding Udacha (Vilnia x Anoka).

The hybrids showed different maturity, depending on hybrids gradation adopted in UPOV procedure, that ranged from early to mid-season (Table 9).

Table 9. The results of the study of hybrids of different combinations in the nursery of the main test selection FSBEI HE Gorsky SAU in mountainous areas of North Ossetia - Alania.

Field #	Variety, hybrid	Origin	Ripeness group	Tubers yield, g/bush	Yield, t/ha	% of marketable tubers	The average mass of 1 marketable tuber, g	Infestation with phytophthora, points		% of virus infestation			Tuber, points				Bush				
								of topper	of tubers	X	S	M	shape	colour	eyes depth	eyehole colour	Height, cm	number of stems, pcs/bush	flower painting	berry production	power of development, points
1.	Udacha	Vilnya Anoka	I	454.4	21.35	95.2	72.16	8	9	0.0	0.0	0.0	4	1	7	1	70-75	5	w.	mid.	9
4.	10.11/181	Roko Romano	II	308.8	30.85	94.86	110.1	7	7	0.0	0.0	0.0	2	3	5	1	55-60	5	w.	week	5
14.	10.2/56	Bars Adretta	II	567.2	30.88	98.5	96.5	8	7	0.0	0.0	0.0	4	1	5	1	65-70	6	l.-lil.	abundant	5
15.	10.2/316	Bars Adretta	II	737.8	29.97	96.1	84.7	7	7	0.0	0.0	0.0	2	1	3	3	65-70	6	w.	week	9
HCP_{05}					8,73																

Research showed that the average yield of hybrids of the main testing nursery was below the prior and was 25.8 t/ha, with the maximum for 10.11/181 and 10.2/56 (30.85 and 30.88 t/ha) and minimum for 10.11/535 (16.64 t/ha). Marketability was high, not less than 90.2%, reaching an average of 95.9%.

Average weight of 1 marketable tuber varied widely from 49.6 (10.2/153) to 110.1 g (10.11/181). It should be noted that in respect of this feature the leading variety was Udacha (72.16-119.6 g). Assessment of hybrids resistance to fungal and viral diseases showed a high enough resistance to late blight of both foliage and tubers (average 7.7 points) and absolute immunity to viruses X, S, M.

The prevalence in this nursery of hybrids with white color of the skin, the average depth of the white eyes was noted. The height of the bush was in the range of 55-75 cm, also we noted high level development of plants, firmness of stems. Berry production in general was average. In the nursery of the main test we also performed biochemical assessment of potato tubers (Table 10).

Table 10. The content of starch and dry matter in hybrid potato main test nursery.

No.	Hybrid	Content,%	
		of dry matter	of starch
1.	10.11/927	16.1	10.4
2.	10.3/228	16.3	10.5
3.	10.2/664	17.1	10.7
4.	10.11/870	17.4	11.6
5.	10.11/926	17.4	11.7
6.	10.11/763	18.1	12.3
7.	10.11/1136	18.8	13.0
8.	10.11/1140	18.7	13.0
9.	10.11/334	19.9	14.1
10.	10.11/181	20.3	14.6
11.	10.11/640	20.4	14.7
12.	10.11/535	20.5	14.8
13.	10.2/153	21.0	15.3
14.	10.2/153	22.0	16.2
15.	10.2/56	21.9	16.2
16.	10.11/716	22.0	16.2

17.	10.4/316	22.4	16.6
18.	10.11/1985	23.9	18.2
19.	10.11/765	24.1	18.4
20.	10.11/839	25.5	19.3
21.	10.11/1286	25.2	19.4
22.	10.11/1144	25.8	20.1
23.	10.11/770	25.9	20.1
24.	10.11/947	31.8	26.0

Potato value is determined by the content of starch. Studies show that the average amount of starch and dry matter across the hybrids was high and was at 21.4% and 15.6%, respectively, with the maximum achieved by hybrid 10.11/947, the starch content of which was 26% (high). Waxy hybrids were 10.11/927, 10.3/228, 10.2/664, 10.11/870 10.11/926 10.11/763 10.11/1136 10.11/1140 (10.4 - 13.0%).

5. Conclusion

1. In the process of hybridization the varieties of different maturity groups in the parental nursery were studied. As the result of interbreeding we obtained 830 genotypes of year I for transition of seedlings of year II to the nursery, 48 - for year III, and 433 hybrids for preliminary test. Thus, FSBEI HE Gorsky SAU involved in the hybridization 1,411 hybrids in the selection, which will be continued in the future. 6 hybrids of the 1st year laboratory test of 11th combination (10.11/870 10.11/839 10.11/1136 10.11/770 10.11/927 10.11/926) and 4 hybrid of the 2nd year (10.3/228 10.11/765 10.11/763, 10.2/153) were sent to the Russian centre for testing for cancer and Globodera rostochiensis.

2. The assessment of phenotypic traits showed a significant difference between the hybrids in shape of the tuber, the depth eyes and other valuable economic and biological features.

3. The studies carried out in the preliminary test nursery for hybrids of combination 30 (Predgorny x Libana), 34 (Innovator x Sinyukha) and 37 (Sinyukha x Kuznechanka) showed their high marketability with an average amounting to 96.9% and productivity, the maximum of which reached 56.4 m/ha (11.34/1), which was 17.9 t/ha higher than the average of 38.5 t/ha.

4. The best results by the complex of economically valuable traits showed hybrid 11.34/1 (Innovator x Sinyukha), which possessing high marketability (99.5%), productivity (56.4 t/ha) and absence of viral diseases and

small eyes.

5. The obtained results can be used in the preparation of disease-resistant potato seeds, which have the complex of positive traits.

References

1. Alsmik, P. I. and V.V. Safonova, 1979. Ocenka kartofelja v Belorussii. Vlijanie temperatury i osadkov na prirost klubnej kartofelja vo vtoroj period vegetacii [Assessment of Potato in Belarus. The Effect of Temperature and Precipitation on the Growth of Potato Tubers during the Second Vegetation Period]. Minsk: Harvest, pp: 127.
2. Antonova, O. Y., N.A. Shvachko, L. I. Kostina, L. L. Malyshevand T. A. Gavrilenko, 2004. Geneticheskaja differenciacija sortov kartofelja s ispol'zovaniem SSR markerov [Genetic Differentiation of Potato Varieties with the Use of SSR Markers]. Agrarian Russia, 6: 19-24.
3. Basiev, S.S., P.M. Shorin and A.N. Scherbinin, 2010. Agrobiologicheskie osnovy tehnologii proizvodstva i hranenija kartofelja v uslovijah vertikal'noj zonal'nosti Severnogo Kavkaza [Agrobiological Basics of the Technology of Potatoes Production and Storage in the Conditions of the Vertical Zonality of the North Caucasus]. Vladikavkaz: Publishing House of FSEI HVE "The Gorsky State Agrarian University", pp: 152.
4. Basiev, S.S., Z.A. Balieva, C.G. Dzhioeva and F.T. Gareeva 2015. Osobennosti selekcii kartofelja v gornoj i predgornoj zonah RSO-Alanija [Peculiarities of Potato Breeding in the Mountainous and Submontane Areas of the Republic of North Ossetia–Alania].In the Proceedings of the international scientific and practical conference "Ways of Increasing Competitiveness of Domestic Varieties, Seeds, Planting Material and the Technology in the World Market. Crimea: Simferopol, pp: 10-18.
5. Bezvirusnoe semenovodstvo kartofelja [Virus-free Potatoes Seed Production], 1990. Moscow: Agropromizdat, pp: 32.
6. Byasov, K.H. et al., 2000. Pochvy Respubliki Severnaja Osetija – Alanija [Soils in the Republic of North Ossetia – Alania]. г.Владикавказизд. ПроектПрогресс, pp: 382.
7. Vasilyeva, S.V., 2001. Bakterial'nye bolezni kartofelja i mery bor'by s nimi [Bacterial Diseases of Potatoes and Methods of Their Control]. Potatoes and Vegetables, 3: 46-47.
8. Drygin, Y.F. and S.N. Chirkov, 2007. Kartofelevodstvo Rossii: aktual'nye problemy nauki i praktiki [Potato Growing in Russia: Actual Problems of Science and Practice]. Moscow: MSU, pp: 17-25.
9. Zykin, A.G., 1976. Virusnye bolezni rastenij [Viral Diseases of Plants]. Leningrad: Kolos, pp: 152.

10. Layman, P.O., 1987. Polevaja ustojchivost' sortov kartofelja k povtornomu zarazheniju virusami v uslovijah suhostepnoj zony Severnogo Kazahstana [Field Resistance of Potato Varieties to Re-infection with Viruses in the Conditions of the Dry Steppe Zone of Northern Kazakhstan]. Collection of Scientific Works in Applied Botany, Genetics and Plant Breeding. The All-Russia Research Institute of Plant Breeding n.a. Vavilov, 110: 37-41.
11. Maksimovich, M.M., 1951. Metody selekcii kartofelja [Methods of Potato Breeding]. Moscow: Selkhozgiz, pp: 158.
12. Metodicheskie ukazanija. Sistema integrirovannoj jekologicheski bezopasnoj zashhity kartofelja ot boleznej, vreditelej i sornjakov [Methodical Instructions. A System of Integrated Environmentally Safe Protection of Crops from Diseases, Pests and Weeds], 2010. Moscow: Rosselkhozakademia VNIIKH, pp: 38.
13. Peresypkin, V.F., 1990. Bolezni tehnicheskih kul'tur i kartofelja [Diseases of Commercial Crops and Potatoes]. Harvest, 2: 175.
14. Pleshakova, T.S., 2002. Kak podgotovit' klubni k posadke [How to Prepare Tubers for Planting]. Potatoes and Vegetables, 2: 12.
15. Safin, R.I., 2001. Sistema zashhity kartofelja ot boleznej [The System of Protecting Potatoes from Diseases]. Agro XXI, 9: 5.
16. Serdyukov, A.E. and A.S. Volovik, 1988. Snizit' poteri klubnej ot boleznej [Reducing Tubers Losses from Disease]. Potatoes and Vegetables, 4: 45-47.
17. Simakov, E.A., 2011. Perspektivy napravlenija razvitija selekcii i semenovodstva kartofelja [Prospects of the Area of Potatoes Breeding and Seed Production]. Moscow: "VINITI" - "Science", pp: 35-40.
18. Simakov, E.A., I. M. Yashina and N. P. Sklyarov, 2007. Selekcija kartofelja v Rossii: istorija, obshhie tendencii i dostizhenija [Potatoes Breeding in Russia: History, General Trends and Achievements]. Moscow: "VINITI", pp: 30-40.
19. Solomina, V. F., K. M. Mukhametzhanov and M. Amirzhanova, 1988. Immunofermentnaja diagnostika virusov kartofelja [Immunoenzymometric Diagnostics of Potato Viruses]. Issues of Breeding and Plant Introduction in Central Kazakhstan]. In Collection of Scientific Works of Karaganda. Karaganda: "Form Plus", pp: 85-86.
20. Trofimets, L.N., 1971. Nekotorye osobennosti infekcionnogo processa pri zarazhenii kartofelja virusami M, S, Y [Some Peculiarities of the Infectious Process in Case of Potatows Infection with Viruses M, S, and Y]. Moscow: Potato Research Institute, pp: 244-251.

21. Cherkashin, V.I., V.L. Solodkaya, I.N. Yakovleva and N.Y. Kvasnyuk, 2001. Fitosanitarnyj monitoring i zashhita kartofelja ot koloradskogo zhuka i fitoftoroza [Phytosanitary Monitoring and Protection of Potatoes from Colorado Potato Beetles and Late Blight]. Potatoes and Vegetables, 3: 42-44.
22. Shelabina, T.A., 1989. Ustojchivost' k virusam rajonirovannyh sortov kartofelja i osobennosti zashhity ih v Severo-Zapadnom regione Nechernozem'ja [Resistance of Zoned Potato Varieties to Viruses and Peculiarities of Potato Varieties Protection in the North-Western Region of the Non-Black Earth Belt]. Author's abstract from the Dissertation for the Candidate Agricultural Sciences. Leningrad, pp: 21.
23. Shmyglya, V.A., D.A. Postnikov and P.F. Kinyakin, 1990. Himioterapija virusnyh boleznej [Chemotherapy of Viral Diseases]. Chemicalization of Agriculture, 5: 57-59.
24. Yashina, I.M. and F.P. Glukhov, 1997. Projavlenie izmenchivosti u ozdorovlennyh rastenij kartofelja [Manifestation of Variability in Sanitized Potato Plants]. In the Proceedings of the VII International Conference (25-28 November 1997) in the Russian Academy of Sciences, the Institute of Plant Physiology n.a. Timiryazev. Moscow, pp: 489.
25. Paul, S.M., G.S. Shekhawat, B.P. Singh and S.K. Pandey, 2000. Potato, Global Research and Development. Shimla: Indian Potato Association, pp: 733.
26. Struik, P.C. and S.G. Wiersema, 1999. Seed Potato Technology. Wageningen: WageningenPers, pp: 383.
27. Nacheva, E. et al., 2013. Characterization of Agrobiological Response of Mid-early Potato Breeding Lines and Varieties in Biological Production. Crop Sciences, 50 (3): 80-85.
28. Nacheva, E., V. Blagoeva, S. Masheva et al., 2013. Comparative Analysis of Biological and Economic properties of Bulgarian Potato varieties. Crop Sciences, 50 (3): 86-90.
29. Lai M., S.K. Luthra, B.P. Sihgh and S. Yadav, 2013. Screening of Genotypes Against Potato Late Blight. Journal of the Indian Potato Association, 40 (1): 80-83.
30. Gedif, M. and D. Yigzaw, 2014. Genotype x Environment Interaction Analysis for Tuber Yield of Potato Using a GGE Biplot Method in Amhara region, Ethiopia. Journal of the Indian Potato Association 41 (1): 41-51.
31. Hammann, T., 2013. Inwertsetzung wilder Verwandter der Kartoffelzur Entwickluhg von genetischerweitertem Keimplasmamitverbesserter Resistenzgegen die Kraut- und Knollenfaule (Pnytophthoroinfestans). Journal fur Kulturpflanzer, 65 (7): 285-292.
32. Czerko, Z., M. Grudzinska and K. Zgorska et al., 2013. Comparison of Registered Potato Varieties and New

Breeding Lines in Respect of Storage Losses. Biul. Inst. Hodowli Aklimat. Rosl. Warszava. N 269, pp. 101-114.

33. Yuldashev, F., C. Carli and K. Partoev, 2012. Suitability of CIP – Bred Potato Clones as Male Parents for Crossing Programme Under Long Day Conditions of Central Asia. Journal of the Indian Potato Association, 39 (2): 205-207.
34. Wrobel, S. and B. Robak. 2014. B. New Potato Cultivars Characterized in Regard to Dormancy Breaking of Tubers. Biul. Inst. Hodowli Aklimat. Rosl. Warszava. N 272, pp. 93-101.
35. Da Silva G.O., V.G. Ney, A. Da Silva Pereira and L.R. Terres, 2014. Relationships Among Potato Tuber Traits in Early Generations of Selections. Rev. Ceres. Viçosa, Minas Gerais. V. 61. N 3, 370-376.
36. Dalamu, Singh B. and V.K. Gupta, 2014. Biochemical Profiling of Phytonutrients for Breeding Nutrient Rich Potatoes. Journal of the Indian Potato Association, 41 (2): 122-129.
37. Kumar, R., 2014. Combining Ability of Improved Andigenacloneain Andigena x Tuberosum crosses. Journal of the Indian Potato Association, 41 (2): 180-184.
38. Pradhan, A.M., K.K. Sarkar and A. Konar, 2014. Studies on Genesis for Yield and Storability of Potato. Journal of the Indian Potato Association, 41 (2): 160-165.